AUTOMATION AND MECHANIZATION

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IMPROVING THE DOSING OF MINOR COMPONENTS OF THE GLASS BATCH

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The design and the operating principles of screw feeders for low-content components of a glass batch and a dosing complex for preparation of a premix of selenium and cobalt oxide with a filling agent are considered.

Glass batch materials are considered to be minor or low-content components when their content in the mixture constitutes some fractions of a percent. The minor additives and microadditives are used as colorants or decolorizing agents in the glass batch and also to impart certain physicochemical properties and technological characteristics to glass. The estimated content of decolorizing agents in a batch is 1.4 – 1.7 g Se and 0.07 – 0.08 g CoO per 100 kg of the glass batch [1]. In practice, selenium and cobalt oxide are usually weighed on a desk scale in the laboratory conditions [2] and manually added to the mixing vessel in their pure form or in previously prepared mixtures (premix).

To perform dosing of low-content glass batch components, Stroiizmeritel' JSC has developed two modifications of the screw spiral feeder, a dosing complex, a dosing-mixing complex, and a mixing device for small quantities.

The spiral screw feeder (Fig. 1) consists of the case *1* with the charging funnel *2*, a drive *3*, a hollow belt screw *4*, a spiral screw *5* of small diameter, an outlet pipe branch *6*, and a material collector *7*.

The feeder operates as follows. The material from the service bunker arrives by gravity into the charging funnel; the hollow belt screw and the small-diameter spiral screw are coaxially installed on the drive shaft in the bottom part of the charging funnel. In counterclockwise rotation the hollow belt screw starts loosening the material and pushing it towards the outlet pipe, whereas the collector of material is placed at the entrance to this outlet pipe. The collector is shaped like a hyperbolic spiral segment, i.e., a flat curve that is described by a moving point on a rotating straight line in such a way that its distance from the rotation center is inversely proportional to the rotation angle. The initial branch of the collector encompasses the lower part of the small-diameter spiral crew at the entrance to the outlet pipe and prevents the material from falling through the hollow spiral coils. The final branch of the collector has clockwise coiling and partly encompasses the small-diameter spiral screw to the left of the direction of material migration. The collector of material in its upper part is limited by the inner surface of the hollow belt

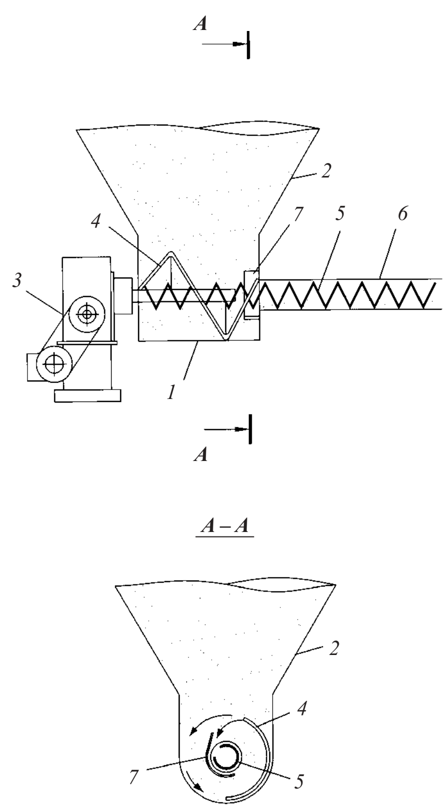

Fig. 1. Spiral screw feeder.

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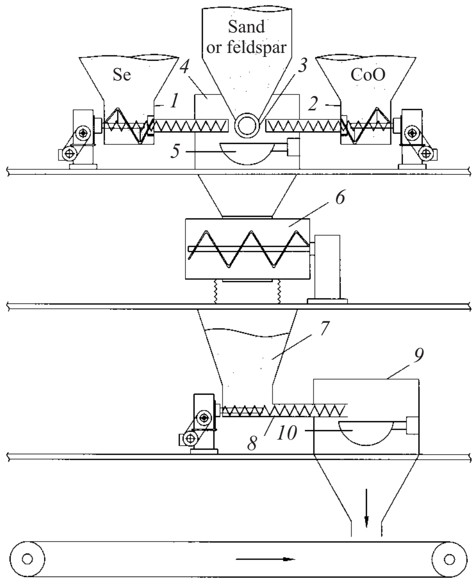

Fig. 2. Dosing-mixing set.

screw, so that a small clearance exists between the collector and the final branch of the belt screw.

As the hollow belt screw rotates, the material particles describe a spiral in the lower part of the charging funnel and migrate toward the collector of material. Since the direction of rotation of the material particles is opposite the director of coiling of the spiral-shaped collector, part of the particles veers off to the space limited by the middle part of the collector and the small-diameter spiral screw and gradually transported toward the outlet pipe. The small lumps of material that penetrate into the clearance between the collector and the spiral screw disintegrate, and the larger lumps, whose size exceeds the distance between the spiral screw coils, are thrown off and undergo a rotary movement around the spiral screw until getting into the clearance between the upper branch of the collector and the final segment of the hollow belt screw, where they are effectively broken.

The existence of the spiral-shaped collector makes it possible to develop different speeds of rotation for the outer and the inner layers of the material stirred by the hollow screw, which also contributes to the homogenization of material and prevents the formation of arches and hollow cylindrical channels in the material that needs to be dosed. By modifying the clearance between the collector and the hollow belt screw, as well as the rotation angle of the spiral collector, it is possible to select the optimum mode for the operation of the feeder depending on the properties of the minor components.

The use of this type of feeder in weighing minor additives and microadditives with a wide spectrum of physico-chemical characteristics makes it possible to increase the dosing accuracy not only through the homogenization of materials prone to caking, but also through a more uniform discharge of material regardless of the filling level of the service bunker. Even when the material level is below the feeder drive shaft, portions of the material get lifted by the final branch of the hollow screw near the end wall at the bottom of the charging funnel and are trapped by the spiral collector. In these conditions the material can be completely discharged from the bottom part of the charging funnel, which is very important in dosing raw material prone to caking with pauses in operation (for example, when the machinery is operated in two shifts).

Another modification of the spiral screw feeder is intended for dosing friable materials and premixes, in which the filler is sand, feldspar, and other glass batch materials not inclined to caking. This modification does not include the hollow belt screw and the collector of material, and the outlet pipe with the spiral screw feeder is installed in the bottom part of the receiving funnel.

Spiral screw feeders of both modifications can be used in single-component batchers for small doses, and also in two- and three- component dosing and dosing-mixing complexes produced by Stroiizmeritel' JSC.

The dosing-mixing complex (Fig. 2) contains a three-component dosing set, which includes two screw spiral feeders *1* and *2* for selenium and cobalt oxide, a vibration feeder *3* for sand or feldspar, a strain gage dispenser *4* with a rotary weight-receiving dish *5*, a mixer *6* for small doses, a service bunker for premix *7*, a spiral screw feeder *8* for premix, and a strain gage dispenser *9* for premix with a rotary weight-receiving dish *10*.

Selenium and cobalt oxide are alternately transferred to the rotary weight-receiving dish of the dispenser via spiral feeders *1* and *2* equipped with agitators shaped as hollow belt screws, whereas sand or feldspar is transferred by a vibration feeder to the rotary weight-receiving dish of the dispenser and weighed. As the daily consumption of Se and CoO is 2 – 3 kg and 100 – 150 kg, respectively, per 150 – 200 tons of batch, such quantities of minor additives can be metered in 1 – 6 cycles, with the maximum weighing limit 0.5 – 1.0 kg. After a portion of each material is weighed, the weight-receiving dish performs a full revolution and unloads the material into the small-dose mixer, where all three components are mixed to obtain a premix. After the mixing is completed, the discharge gate of the small-dose mixer opens, and the mixture is poured into the premix service bunker. The spiral feeder *8* without an agitator is installed at the bottom part of the service bunker, and this feeder in accordance with the batch formula and the operating cyclogram of the dosing-mixing set pours a certain portion of the mixture to the rotary weight-receiving dose dish. After weighing a premix portion, the weight-receiving dish rotates and discharges the material either on the accumulating conveyor belt or to the glass batch mixer.

Technical characteristics of the dosing-mixing complex

Weighing limit, kg	0.05 – 1.00
Weighing error, %	0.1 – 0.2
Dosing cycle duration, min	3 – 5

Number of feeders	3
Spiral feeder diameter, mm	18 – 28
Feeder output, liter/min:	
spiral	0.2
vibration	1.5
Mixer capacity, liters	6.0
Mixer output, kg/h	50
Power voltage, V	220/380 ± 10%
Power consumption, kW	1.5

Similar equipment for dosing minor components of the glass batch is produced by the well-known ZIPPE Company (Germany).

The use of strain-gage weighing dispensers for minor components, as well as dosing and dosing-mixing complexes for making premixes, makes it possible to completely automate the production of the glass batch and significantly improve its quality.

REFERENCES

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